Existing Indicator Assessment and Additional Indicator Development for SDG 6.3

Water Research Commission

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List of Abbreviations

CSIR	Council for Scientific and Industrial Research
DFFE	Department of Forestry Fisheries and the Environment
DWS	Department of Water and Sanitation
GEMS	Global Environmental Monitoring System
IRIS	Integrated Regulatory Information System
MDG	Millennium Development Goal
MEA	Multilateral Environmental Agreement
PSP	Professional Services Provider
RQO	Resource Quality Objectives
SANBI	South African National Biodiversity Institute
SDG	Sustainable Development Goal
SRK	SRK Consulting South Africa (Pty) Ltd
StatsSA	Statistics South Africa
UN	United Nations
VNR	Voluntary National Review
WRC	Water Research Commission
WSA	Water Service Authority
WWTW	Wastewater Treatment Works

1 Introduction and Background

1.1 The UN Sustainable Development Goals

South Africa is one of 193 countries committed to achieving the Sustainable Development Goals (SDGs). SDG 6: Clean Water and Sanitation, is one of these goals. The lead entity responsible for the policy, plans and implementation programmes affecting the ambitions of SDG 6, is the Department of Water and Sanitation (DWS). In adopting the goal, the DWS adopted existing indicators (carried over from the United Nations [UN] Millennium Development Goals [MDGs]), domesticated some indicators, and defined additional indicators.

In May 2017 the UN released the first round of the Step-by-step Methodology Reports for each of the indicators. Revisions of these methods have subsequently been published through updated methodology reports and captured in the 2018 Synthesis Reports for each indicator. At a national level, countries were encouraged to domesticate these methods and to set targets that are relevant to their context and resources, while maintaining consistency with the targets set out in the SDGs.

While South Africa has developed methodologies to domesticate our indicators, some of the indicators are still not being measured in a meaningful way that shows and drives progress against the targets. For some of these indicators, an assessment, and potentially, a revision of these methodologies is required. For others, new methodologies are required to be developed. In addition, several new indicators are required, and a solid founding methodology is required for the new indicators.

1.2 SDG 6 Adoption in South Africa

SDG 6 has been divided into 8 targets, which are then divided into indicators. The intent of setting targets and defining indicators is to allow for monitoring of progress in achieving SDG 6. The DWS works closely with several other branches of government (e.g. the Department of Forestry, Fisheries and the Environment [DFFE]), as well as other organisations (e.g. the Water Research Commission, Council for Scientific and Industrial Research, etc.), to measure and report on the indicators. The objective of monitoring and reporting on the indicators is to effect real change in the water and sanitation landscape in South Africa, by informing policy and strategy formulation and aiding decision-making when planning and implementing interventions.

South Africa has reported on SDG 6 progress in several reports to date; including the 2016 Community Survey, SDG Baseline Report in 2017, SDG Country Report in 2019, and 2019 General Household Survey. In addition, Statistics South Africa (StatsSA) has partnered with Data Act Lab (a collaboration with SIDA [Swedish International Development Cooperation Agency]) to develop a Goal Tracker portal (Data Act Lab, 2021). The reports and portal show that several indicators are not tracked, that data continuity is poor for some indicators, and that there is a lack of consistency in tracking some indicators.

The DWS and Water Research Commission (WRC) have identified indicators within SDG 6 that present challenges with data availability, data collection, calculation, or reporting. The two organisations appointed a working group, to evaluate targets, indicators, and methodologies for SDG 6.6, 6.3 and 6.b; and to propose improvements where shortfalls are identified. This report deals with the indicators for SDG 6.3.

2 SDG 6.3 Background

SDG 6 aims to monitor all aspects relating to freshwater to ensure the availability and sustainable management of the resource (South African Government, 2019). SDG target 6.3 focuses specifically on water quality and wastewater with the ultimate motive of improving the quality of the resource.

The presence of increased waste in our water bodies poses a serious health hazard both to humans and ecosystems, which makes it crucial to address this issue and minimize the associated impacts. Therefore, monitoring all water bodies and gathering data for all relevant aspects pertaining to this target is necessary to be able to keep track of the quality of freshwater, and based on the quality, to develop or undertake measures for improvement (UN Water, 2022). Currently, the discharge of waste from agricultural, industrial and urban areas has significantly contributed to the deterioration in the quality of surface water bodies. This is one of the key concerns that needs attention when addressing SDG Target 6.3.

On a global scale, there are two indicators for SDG Target 6.3: indicators 6.3.1 and 6.3.2:

- SDG Indicator 6.3.1 monitors the proportion of wastewater from residential, urban and industrial areas that is safely treated (UN Water, 2022). The World Health Organization (WHO) and United Nations Human Settlements Programme (UN-Habitat) are the responsible organisations for this aforementioned indicator.
- SDG Indicator 6.3.2 focuses on monitoring the percentage of water bodies with good ambient water quality (UN Water, 2022). These bodies of water include rivers, lakes as well as groundwater. This indicator aims to ensure that the quality of water is good enough to maintain healthy ecosystems and not to pose any health hazards to human life. Water quality is monitored using an index, which comprises five parameters: oxygen, salinity, nitrogen, phosphorus and acidification (i.e. pH). These parameters are used as they are sensitive to changes in water quality (UN Water, 2022).

On a national scale, both of these indicators have been domesticated for adaptation to the current situation in South Africa:

- 6.3.1D: Discharge of Water Containing Waste; and
- 6.3.2D: Raw Water Quality.

Furthermore, three additional indicators were developed with a focus on recycling of water containing waste, disposal of waste and recycling of waste:

- 6.3.3A. Proportion of water containing waste recycled or reused;
- 6.3.4A. Proportion of waste lawfully disposed of; and
- 6.3.5A. Proportion of waste recycled or reused.

These additional indicators have not been formally adopted yet, and do not have methodologies developed for their monitoring and reporting. They focus specifically on minimizing the amount of waste reaching the water bodies, which would ultimately result in good quality of freshwater resources (DWS, 2021). This focus is aligned with the ambitions of SDG Target 6.3:

> *By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.*

SDG Indicator 6.3.4A and SDG Indicator 6.3.5A both pertain to solid waste, and duplicate existing indicators in other SDGs. This is explored further in Section 4.1.

2.1 Overview of SDG Target 6.3 progress

The DWS has monitored progress against the SDG Target 6.3 indicators since their adoption in 2015. The decision was taken to domesticate the indicators in 2018. The monitoring serves to track progress internally (within South Africa), and to gather data and report progress to the UN.

The following statements on progress against SDG Indicator 6.3.1D and 6.3.2D are paraphrased from the Voluntary National Review of 2019 (South African Government, 2019):

- South Africa has seen improvements relating to safe water and basic services over the years. However, rural areas are still facing challenges due to rural municipalities lacking the capacity and skills that are needed for the provision of water services. This has resulted in the poor operation and maintenance of water related infrastructure.
- In 2016, approximately 40% of water bodies in South Africa had poor water quality resulting from pollution and the destruction of river catchments. The pollution includes point-source and non-point sources of waste discharge.
- In 2017, 52% of wastewater going through wastewater treatment works (WWTWs) was safely treated and lawfully discharged into the water resource. Other sectors that discharge wastewater, such as mines, are not included in this number.

The detailed information on how the indicators track performance against SDG Target 6.3 over time is shown and discussed in Section 4.1.

The challenges in collecting data for SDG Indicators 6.3.3A, 6.3.4A and 6.3.5A include:

- Data are not gathered in a coordinated fashion;
- No information management system is currently available for SDG Indicators 6.3.3A;
- Some municipalities are not submitting data.

3 Problem definition

The ultimate ambition of SDG Target 6.3 is improved ambient water quality. This is outlined in the UN definition of the target:

> *By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.*

Increased recycling and reuse of waste and water containing waste supports this ambition; and, in the case of the recycling or reuse of water containing waste, reduces demand for raw water.

Methodologies have been developed for SDG Indicators 6.3.1D and 6.3.2D; while methodologies for the additional three indicators have not been developed yet. A summary of the status of the SDG 6.3 indicators is shown in Table 3-1 below:

Table 3-1: Current SDG 6.3 indicators in South Africa

Indicator		**Extent**	**Status**
6.3.1D	Discharge of water containing waste	Domesticated	Active
6.3.2D	Raw water quality	Domesticated	Active
6.3.3A	Recycling of water containing waste	Additional	Inactive
6.3.4A	Disposal of waste	Additional	Inactive
6.3.5A	Recycling of waste	Additional	Inactive

This research problem is split into three:

- Problem: lack of understanding of the relationship between SDG Indicator 6.3.1D, SDG Indicator 6.3.2D, and ambient water quality, over time;
    - Research objective:
        - assess existing data to attempt to determine this relationship / correlation;
        - compare the Resource Quality Objectives (RQOs) compliance data to the Global Environmental Monitoring System (GEMS) data, and assess RQO readiness to replace GEMS data
- Problem: absence of methodology for collecting data, calculating and reporting on SDG Indicator 6.3.3A;
    - Research objective: develop a methodology for collecting data, calculating and reporting on this indicator (Recycling of water containing waste);
- Problem: absence of methodology for collecting data, calculating and reporting on SDG Indicators 6.3.4A and 6.3.5A; noting that there are indicators in other SDGs that report on solid waste disposal and recycling;
    - Research objective: develop methodologies for collecting data, calculating and reporting these two indicators, if the decision is taken to duplicate the reporting of indicators by two departments (collaboration between the departments can be implemented).

4 Research Sub-tasks

4.1 Assessment of relationship between SDG 6.3.1D and SDG 6.3.2D over time

4.1.1 Voluntary National Review and SDG Country Report of 2019

Wastewater discharge and ambient water quality are parameters that have been monitored by South African authorities in one form or another for many years prior to the definition and adoption of the specific indicators SDG Indicator 6.3.1 and SDG Indicator 6.3.2 in 2015. The Voluntary National Review published in 2019 (South African Government, 2019) stated the following in relation to these two indicators:

- Wastewater discharged (SDG 6.3.1): 52% of wastewater going through WWTWs was safely treated and lawfully discharged into the water resource;
- Ambient water quality (SDG 6.3.2): 40% of water bodies had poor water quality."

These statistics were duplicated for the SDG Country Report of 2019, with the following additional commentary:

- SDG 6.3.1D: Municipalities are guilty of non-submission of water-quality data to the Integrated Regulatory Information System (IRIS)
- SDG 6.3.2D: South Africa's reporting ability on this indicator has been reduced by the lack of data, limited monitoring due to lack of funding and resource mobilisation, and to a certain degree the inability to coordinate monitoring across various sectors, government departments and public sector institutions. Data on instream and in-aquifer water-quality monitoring across South Africa has been steadily declining since 2015. This is largely as a result of the financial

constraints that have affected both the collection of water-quality samples as well as the analysis of the samples by the DWS laboratories.

4.1.2 UN Data Drive of 2020

In 2020, the UN-Water Integrated Monitoring Initiative had a Data Drive for SDG 6; in line with their ambition to "Ensure availability and sustainable management of water and sanitation for all". The Data Drive involved countries collecting and reporting data on various SDG 6 indicators to multiple UN agencies, coordinated by UN-Water, as well as to the UN (DWS, 2020). There is a discrepancy in alignment of the data requested by the UN and the SDG reporting – in that the indicators are not the same. The DWS informed the UN of this discrepancy but was not successful in obtaining clarification. The DWS resolved to report on the data that they collect and have available.

4.1.3 Methodology Document of 2021

In order to address some of the above issues and to formalise monitoring and reporting on SDG Target 6.3; a methodology document for SDG Target 6.3 was published in January 2021 (DWS, 2021). The methodologies for SDG Indicator 6.3.1D and 6.3.2D are well developed and summarised below:

- The lead organisations are clearly defined;
- The indicator data for SDG 6.3.2D is divided into quaternary catchments, which are well-defined and delineated for South Africa.
- Management targets are defined
- Cost estimates to achieve the monitoring requirements are available
- The indicator data is available.

It should be noted that collect data from the GEMS site. However, we are working towards reporting on compliance to RQOs

4.1.4 Indicator movement over time for SDG 6.3.1D and 6.3.2D

The progression over time of SDG 6.3.1D is shown in the below graph supplied by the DWS (DWS, 2022), followed by commentary by the DWS:

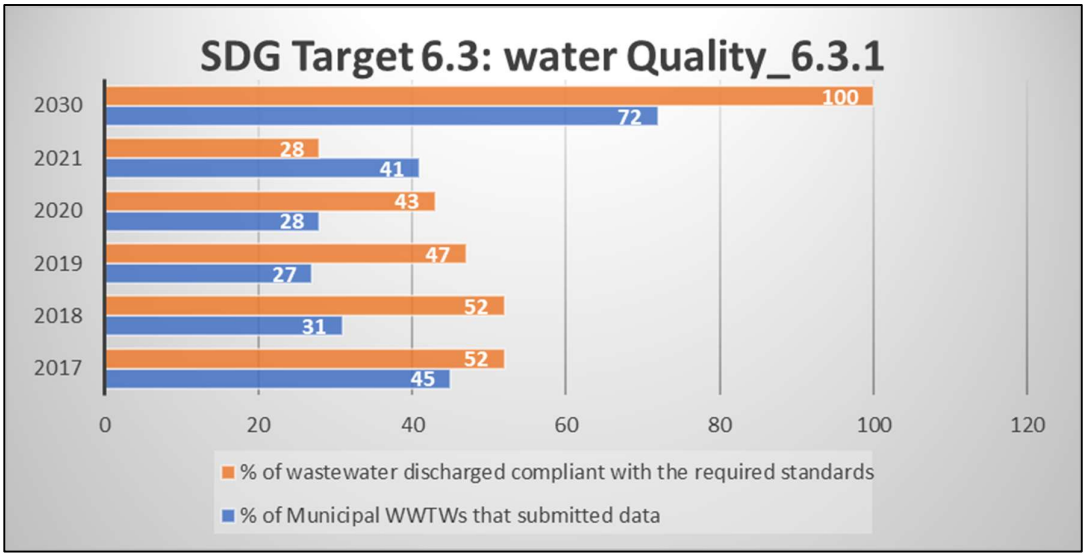

Figure 4-1: Wastewater quality compliance target

The SDG 6.3.1D 2030 target is to: "*Halve the proportion of wastewater that is not lawfully discharged by 2030*" (i.e. using 2017 as the baseline, this means 76% of Municipal discharges must be lawful). There is evidence of a drop or reduction in effluent quality compliance due to lack of submission of effluent quality results onto IRIS and/or monitoring. The percentage of WWTWs that have Water Use Authorisations, and discharge into a water resource, and submitted data onto IRIS; reduced between 2018 and 2020, but increased again in 2021. Therefore, South Africa is not on-track to achieving the set target. A great improvement in data is needed to understand the extent and location of the problem.

Wastewater regulation in the country is conducted by the DWS through the monitoring of effluent quality and Water Use Licence conditions. Since the inception of the Green Drop Certification process, attention has been given to the actual service of wastewater collection, treatment and discharge. However, the discharge of effluent (water containing waste) remains a Section 21 Water Use as legislated in the National Water Act. Data provided above in Figure 4-1 is based on results from municipal WWTWs as captured in IRIS by municipalities. Data provided above excludes wastewater treatment works that discharge into sea outfall, non-discharge treatment technologies such as Oxidation Ponds and those treatment works that use effluent for irrigation.

The progression over time of SDG 6.3.2D is shown in the below graph supplied by the DWS (DWS, 2022), followed by commentary by the DWS:

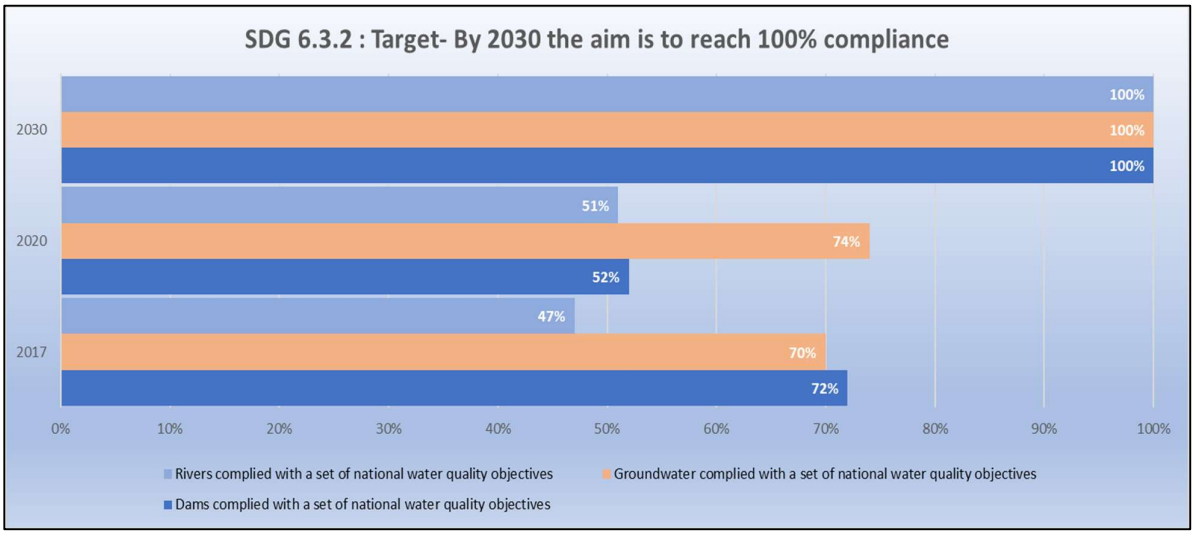

Figure 4-2: Proportion of water bodies that comply with the water quality objectives

The SDG 6.3.2D 2030 target is that: "*100% of bodies of water comply with the water quality objectives*".

Figure 4-2 reveals that 2017 data showed that 72% of dams and 70% of groundwater complied with a set of national water quality objectives, however only 47% of the water quality in rivers complied (baseline data). In comparison during the 2020 Data Drive, 52% of dams and 74% of groundwater complied with a set of national water quality objectives; and 51% of the water quality in rivers complied. For the dam results, the reason for the drop in water quality is a mixture between worsening water quality and the fact that:

- Between 2014-2016, the results were based on 76 586 samples;
- Between 2017-2019, the results were based on far fewer samples (27 784);
- There was a data gap for 2018-2019, as no monitoring was conducted due to financial constraints;

For the groundwater results, the accuracy has been questioned by some stakeholders, as it is known that there are areas with poor groundwater quality. The groundwater networks or data would have to be improved to pick these problem areas up.

An attempt is made to show the relationship between SDG 6.3.1A and SDG 6.3.2A over time in Figure 4-3 below.

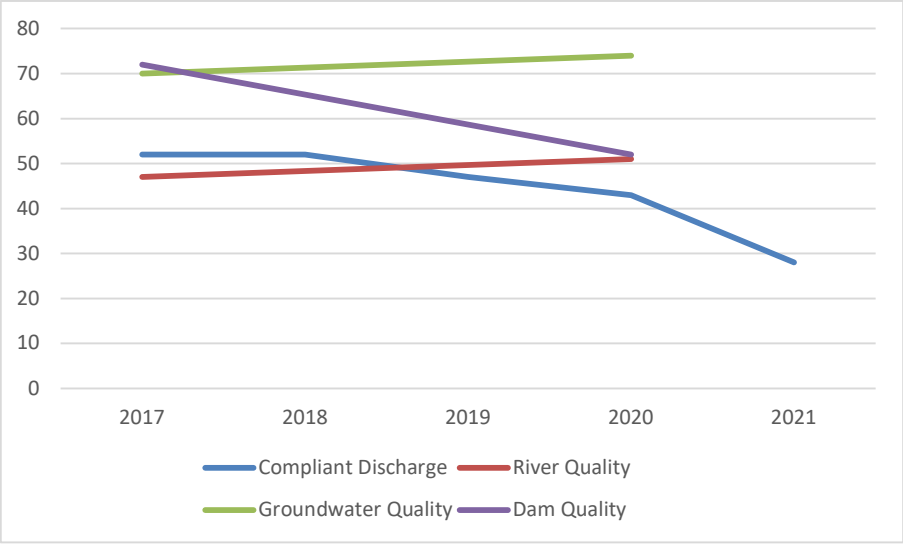

Figure 4-3: Relationship between compliant discharge and quality

It can be concluded that an accurate relationship cannot be calculated due to too few data points for water quality, as well as a significant gap in data collection. Recommendations to remedy this are outlined in Section 5, and are a combination of recommendations identified by the DWS and by SRK.

4.1.5 The introduction of SDG 6.3.3A

SDG 6.3.3A pertains to the recycling of wastewater. According to the DWS, SDG 6.3.3A data is currently only available at municipal level, in the form of the Green Drop system, rather than at quaternary catchment level like SDG Indicator 6.3.1D and SDG Indicator 6.3.2D. This presents a challenge, which could be overcome in a number of ways, as detailed in the SDG Target 6.3 Methodology report, Appendix A, Section A3. Other ways include spatial mapping of overlaps between municipal boundaries and quaternary catchment boundaries. The solutions will largely be dependent on the data available; see Section 5.2 for more detail.

4.2 Identifying duplication in the reporting of waste-related indicators

The new indicators SDG Indicators 6.3.4A and 6.3.5A pertain to solid waste, which falls under the ambit of the DFFE. Table 4-1 lists the SDG indicators that are related to solid waste. More detail and calculations for the indicators listed, follow below the table.

Table 4-1: SDGs containing waste-related indicators

SDG	Target	Indicator
Goal 11: Make cities and human settlements inclusive, safe, resilient and sustainable	**Target 11.6**: By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management	**Indicator 11.6.1**: Proportion of urban solid waste regularly collected and with adequate final discharge out of total urban solid waste generated, by cities

SDG	Target	Indicator
Goal 12: Ensure sustainable consumption and production patterns	**Target 12.4**: By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment	**Indicator 12.4.1**: Number of parties to international multilateral environmental agreements on hazardous waste, and other chemicals that meet their commitments and obligations in transmitting information as required by each relevant agreement
		Indicator 12.4.2: Hazardous waste generated per capita and proportion of hazardous waste treated, by type of treatment
	Target 12.5: By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse	**Indicator 12.5.1**: National recycling rate, tons of material recycled
Goal 14: Conserve and sustainably use the oceans, seas and marine resources	**Target 14.1**: By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution	**Indicator 14.1.1**: Index of coastal eutrophication and floating plastic debris density

4.2.1 SDG Goal 11

Goal 11 aims to ensure that cities are safe and sustainable. Therefore, essential improvements regarding urban settlements are necessary especially when it concerns informal areas (VNR Report, 2019). The amount of people situated in informal settlements has been increasing over the years (VNR Report, 2019). These settlements have inadequate access to services such as water, sewer and electrical connections, which makes it crucial to focus on social and economic development in order to ensure safe more resilient cities (VNR Report, 2019). Target 11.6 specifically focuses on reducing the environmental impacts of cities, which includes indicator 11.6.1, pertaining to solid waste management (Min, 2020). Solid waste refers to any waste produced by households and through commercial and industrial activities (Min, 2020). This indicator aims to ensure that solid waste produced by cities is collected and managed to ultimately improve upon living conditions and promote environmental sustainability (Min, 2020).

SDG indicator 11.6.1 is derived using the following calculation (Ghafari, 2022):

$$x = \frac{Municipal\ solid\ waste\ collected\ and\ managed\ in\ a\ controlled\ facility}{Total\ municipal\ waste\ generated\ by\ the\ city} \times 100$$

Data that is collected for this indicator, however, is undertaken on a regional basis and can be disaggregated at both city and town levels (SDG tracker, 2018a). The correlation of this indicator, in relation to the impact of solid waste management on water resources remains to be created. The water resource monitoring requirements prescribed for the operation of solid waste management facilities, provide a data set that could be utilized for an indicator for SDG 6.3.4A.

4.2.2 SDG Goal 12

SDG 12 aims to ensure sustainable consumption and production patterns. South Africa has focused on improving sustainability through the development of innovative programs that involve recycling

(VNR Report, 2019). However, while several of these programs have been put into place, there is a need for an overall vision that brings all these strategies from different sectors together in order to achieve SDG 12 (VNR Report, 2019). Furthermore, one of the major challenges pertaining to this indicator is the lack of data. On a national level, only SDG indicators 12.2.2 and 12.4.1 are being reported, whilst some indicators currently have no methodologies developed (Min, 2018).

Target 12.4 focuses on the environmental management of chemicals and all wastes throughout their life cycle in order to minimize their impact on both humans and/or the environment (Min, 2018). This target includes indicator 12.4.1, which refers to and assesses several parties that are involved in Multilateral Environmental Agreements (MEAs) and based on each of these agreements, are required to produce and submit any necessary information (Min, 2018). There are five MEAs, as follows (SDG Tracker, 2018b):

- Montreal Protocol
- Rotterdam Convention
- Basel Convention
- Stockholm Convention
- Minamata Convention

Each of these agreements look into different aspects relating to indicator 12.4.1. This indicator is expressed in relation to the degree of compliance of the different parties in reporting necessary information to each of the five MEAs as follows (Ghafari, 2022):

$$Transmission\ Rate = \frac{a_{cs} + b_{cs} + c_{cs} + d_{cs} + e_{cs}}{No.of\ conventions} \times 100$$

where: cs = country score
a, b, c, d, e = Multilateral Environmental Agreements

The calculations pertaining to this indicator are undertaken over a five-year period due to the fact that each of the MEAs are associated with different reporting times (Min, 2018).

Indicator 12.4.2, which also falls under target 12.4, involves an investigation into hazardous waste generation and the proportion of this waste that is treated (SDG Tracker, 2018b). Hazardous waste refers to any waste from households and commercial and industrial activities, that could potentially have a harmful effect on human health and the environment (SDG Tracker, 2018b; Ghafari, 2022). While there are many benefits of using chemicals across different sectors, it becomes equally important to manage hazardous waste associated with such chemicals in order to limit any adverse effects that they may cause. In addition to hazardous waste generated by industries, there are also non-industrial sectors that produce wastes such as sludge, waste oils and batteries (World Bank Group, 2022). Certain issues in monitoring this indicator include limited data due to constraints that may exist within different countries such as insufficient resources and a lack of policies and regulations (World Bank Group, 2022).

The calculations pertaining to this indicator are divided, with the determination of the amount of hazardous waste generated being derived first, which is then followed by the determination of the proportion of hazardous waste treated. These calculations are as follows (Ghafari, 2022):

$$Hazardous\ waste$$
$$= hazardous\ waste\ collected\ through\ munipcal\ services\ or\ private\ companies$$
$$+ hazardous\ waste\ given\ by\ generator\ to\ treatment\ or\ disposal\ facilities$$
$$+ estimation\ of\ hazardous\ waste\ unaccounted\ for$$

$$Proportion\ of\ hazardous\ waste\ treated$$
$$= \frac{quantity\ of\ hazardous\ waste\ treated\ during\ the\ reporting\ year}{total\ quantity\ of\ hazardous\ waste\ generated\ during\ the\ reporting\ year} \times 100$$

The correlation of indicator SDG 12.4.1, in relation to the impact of solid waste management on water resources, remains to be created. The water resource monitoring requirements prescribed for the operation of hazardous waste management, provides a data set that could be utilized as an indicator for SDG 6.3.4A.

Target 12.5 under SDG 12 aims to reduce waste generation through prevention, reduction, recycling and reuse (SDG 12 Hub, 2022). This target consists only of indicator 12.5.1, focussing on the National Recycling Rate (SDG Tracker, 2018b). To ensure the sustainability of the environment in the long-term, it is crucial to reduce waste production and encourage recycling of waste. However, the current situation indicates that recycling rates are significantly low, which makes it extremely important to monitor such indicators relating to waste management and guide countries towards the development and initiation of methods that could reduce the adverse impacts of waste (SDG 12 Hub, 2022). The National Recycling Rate refers to the amount of material that is recycled in a country, plus quantities exported for recycling in relation to the total waste generated in the country, minus any material intended for recycling that is imported (Ghafari, 2022; SDG 12 Hub, 2022). This can be expressed as follows (Ghafari, 2022):

$$National\ recycling\ rate$$
$$= \frac{material\ recycled + material\ exported\ for\ recycling - material\ imported\ for\ recycling}{total\ waste\ generated} x100$$

Due to recycling not being practiced on a large scale, limited data is currently available for recycling rates (SDG Tracker, 2018b).

Indicator SDG 6.3.5A aligns with the proposed reporting of Indicator SDG 12.5.1. The relationship of the country's recycling initiatives needs to be aligned to the benefit this is anticipated to provide in relation to water resource quality. Perhaps utilizing the spatial extent of recycling initiatives in relation to total waste generated or population distribution per area/town or province could provide an indicator to represent the water resource protection due to recycling initiatives. Alternatively, as suggested for indicator SDG 6.3.4A the water resource monitoring requirements prescribed for the operation of solid waste management facilities, where recycling initiatives are in operation, could provide a data set that could be utilized for an indicator for SDG 6.3.5A.

4.2.3 SDG Goal 14

Waste generation is also associated with marine water bodies. Therefore, it is equally important to ensure that these water bodies are clean and safe as they provide many services to both humans and the environment. Target 14.1 focuses on reducing marine pollution particularly from land-based activities such as marine debris and nutrient pollution (SDG Tracker, 2018c). The only two indicators for achieving this target are 14.1.1 (a) and 14.1.1 (b), which aim to minimize marine pollution of all kinds by 2025 (SDG Tracker, 2018c). This indicator monitors the extent of eutrophication and plastic

debris density (UN environment programme, 2022). Eutrophication is caused mainly by the presence of excess nutrients due to factors such as agricultural runoff and wastewater discharge. High levels of eutrophication can result in detrimental impacts such as the disruption of marine ecosystems as well as the loss aquatic life (UN environment programme, 2022). Data collection pertaining to these indicators are undertaken on a global and national level. Global data is collected through earth observations and modelling, whilst national data is acquired by countries that have their respective methodologies (UN environment programme, 2022).

4.3 Monitoring of waste-related indicators in South Africa

The DFFE is the waste sector lead, and as such is responsible for the monitoring of all waste-related indicators in South Africa. The DFFE has historically reported the following indicators:

- SDG Indicator 11.6.1: Proportion of urban solid waste regularly collected and with adequate final discharge out of total urban solid waste generated, by cities;
- SDG Indicator 12.4.1: Number of parties to international multilateral environmental agreements on hazardous waste, and other chemicals that meet their commitments and obligations in transmitting information as required by each relevant agreement;
- SDG Indicator 12.4.2: Hazardous waste generated *per capita* and proportion of hazardous waste treated, by type of treatment;
- SDG Indicator 12.5.1: National recycling rate, tons of material recycled

The DFFE has domesticated SDG 11.6.1, SDG 12.4.1. An environmental sectoral working group (ESWG) has been established between the DWS and DFFE to collaborate on the monitoring of water and waste indicators. The group has committed to signing off on indicators that they will be reporting on (to Stats SA), in September 2022. The sign-off for these indicators needs to be confirmed.

SDG 14.1.1 pertains to plastic in the marine environment. Although SDG 6.3 pertains to fresh water, there is increasing global concern relating to the presence of plastics and microplastics in water. The methodology for this indicator should be studied further and can be converted into one for fresh water; and include the microplastic element in addition to larger plastics.

4.4 Desirability of duplicate methodologies for SDG 6.3.4A and 6.3.5A

Numerous discussions have been held with the DWS and the DFFE. The DWS is of the view that there is a correlation between solid waste disposal and water quality. The question of the magnitude of the impact and the spatial scale remains unanswered.

The DFFE is the custodian of waste data collection, and waste indicator monitoring and reporting. It and it is necessary to establish:

a) Whether these indicators are already being reported under other SDGs by the DFFE;

b) Whether duplication of these indicators is desirable;

c) Whether sufficient waste data is available.

If the answer to a), b) and c) is yes, then the following needs to be ascertained:

d) Whether this reporting is aligned with the ambitions of SDG Target 6.3. If yes, then the existing methodologies can be adopted. If no, then methodologies need to be developed (or existing methodologies modified) for these indicators, which align with the ambition of SDG Target 6.3. In both of these scenarios, collaboration and alignment with the DFFE is necessary to ensure that the correct data is sourced and reported.

If the answer to b) is no; then these indicators should be discontinued.

If the answer to a) and b) is yes, but the answer to c) is no; then the research effort should be directed at sourcing this data. A collaborative effort between the DWS, DFFE, WRC and Professional Services Provider (PSP) will be required to identify and source the data. Existing platforms / sources such as the South African Waste Information System (SAWIS) should be studied to establish the availability, completeness and relevance of the data.

As part of methodology development, customisation, or adoption; management sub-targets should also be defined.

If the methodologies for the proposed additional indicators are developed / customised / adopted, they should be tested using available data (if not already tested by the DFFE), to establish whether they produce the values they were designed to measure. Baselines would need to be developed using existing data. The indicators would need to be tested at a small scale first before testing data sets at the national level, keeping in mind the differences in implementation and reporting across provinces, nationally.

5 Preliminary recommendations

The research thus far has focused mainly on discovering the status quo of the monitoring and reporting of the SDG Target 6.3 indicators, as well as progress from 2015 to 2022. This has raised gaps and further research questions, as detailed below. SRK will attempt to close these gaps, with the DWS and DFFE, before the conclusion of the research project in 2023.

5.1 Improvement of SDG Indicator 6.3.1D and SDG Indicator 6.3.2D monitoring

The following should be instituted in order to close the gaps in monitoring and reporting:

- The municipalities that did not submit data for discharge compliance, should do so retrospectively, using effluent sample quality analyses that were done as part of permit monitoring.
- An attempt to close gaps in quality data for 2017 and 2018 can be made by retrospectively analysing data from Water Use Licence audit submissions, as a proxy for samples not taken in this period.
- Going forward, the number of samples should increase to that of the 2017 number.
- Industrial and mining discharge point sources should be monitored (these can be identified from the Water Use Authorisation database).
- Mining and agricultural non-point sources should be monitored (these can be identified from the Water Use Authorisation database).

5.2 Implementation of SDG Indicator 6.3.3A monitoring

The approach that is proposed (in the current methodology document) to deal with the challenges related to SDG 6.3.3A, is to:

- Assess the available data for usefulness and/or relevance;
- Conduct an investigation into the feasibility of a common information management system (for waste and water containing waste);

The wastewater recycling volumes should be obtained from various sources, including:

The DFFE:

  - Volumes recycled according to Water Use Authorisation conditions
  - Volumes recycled by municipalities. A data drive may be required for this.
- Industries: volumes of wastewater recycling (the amount prevented from being discharged)
- Mining: volumes of wastewater recycling (the amount prevented from being discharged)
- Agriculture: the source and quantity of wastewater used for irrigation.

The data for SDG 6.3.1 needs to be expanded and deficits in the data need to be rectified before SDG Target 6.3.3A can produce meaningful numbers.

5.3 Solutions to link SDG Indicator 6.3.2D with the rest of the SDG Target 6.3 indicators

Suggested solutions are listed in the SDG Target 6.3 methodology document, in Appendix A, Section A3. The extent of data availability for each proposed data source should be established, and a matrix compiled to determine the minimum data sources required to triangulate waste sources and receptors.

5.4 Decision on duplication of indicators

Two meetings should be held to make a decision on the inclusion of these indicators into SDG Target 6.3:

- Meeting with the DFFE Environmental Reporting Unit to establish the extent and completeness of data for solid waste disposal, as well as solid waste recycling.
- Meeting with the SDG Target 6.3 reference group to decide whether to adopt the indicators, and to decide on whether to use existing methodologies or to develop new ones.

If the decision is to proceed with the duplicate indicators; obtain SDG 6.3.4A and SDG 6.4.5A data from the DFFE.

In addition, SDG Indicator 14.1.1 should be converted to two additional parameters within SDG Indicator 6.3.2D: index of floating plastic debris, and microplastic content of water; which would be sampled along with the other parameters for SDG Indicator 6.3.2D.

5.5 Integration of the SDG programme with operational practices

There is significant overlap between the indicators in the SDG programme; for example, the monitoring of water quality, and the monitoring of wastewater discharge from WWTWs and industry. The SDG Indicator 6.3.2D data should be aligned with and retrieved from the resource quality objectives (RQO) database. The SDG Indicator 6.3.1D and 6.3.3A data should be aligned with and retrieved from the Green Drop programme.

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